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# Park Distance Control

Model: E70

Production: From Start of Production

# OBJECTIVES

After completion of this module you will be able to:

- Describe the operation of the Park Distance Control on the E70.
- Diagnose the PDC on the E70.

# Introduction

## Park Distance Control

The Park Distance Control (PDC) is a distance warning system that provides both visual and audible information on the distance to the nearest obstacle when parking and driving out of spaces.

The park distance control is optionally available in the E70.

The distance to the next obstacle is measured by means of four ultrasonic sensors in the rear bumper and four ultrasonic sensors in the front bumper. The distance is signalled audibly via the speakers in the rear and front area of the vehicle. The frequency of the signal increases as the distance to the obstacle decreases.

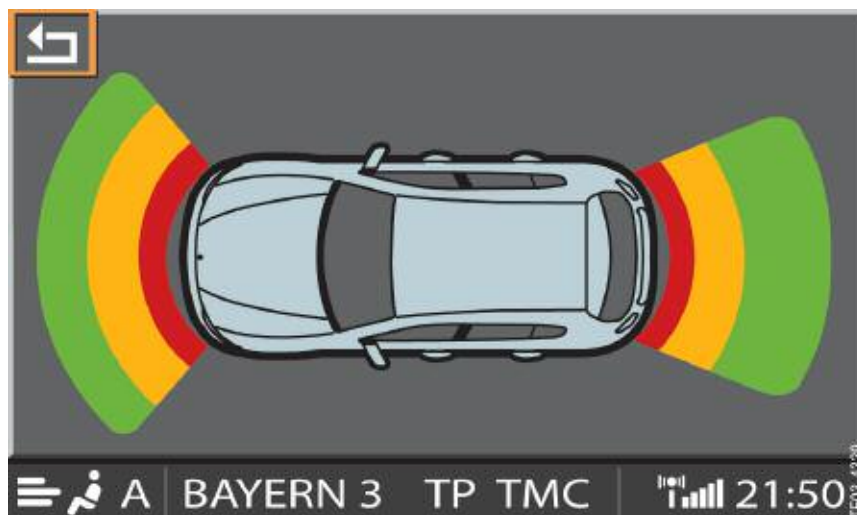
A continuous signal is output in very close proximity to obstacles (about 30 cm).

The distance signalling is shown in graphic form on the central information display CID.

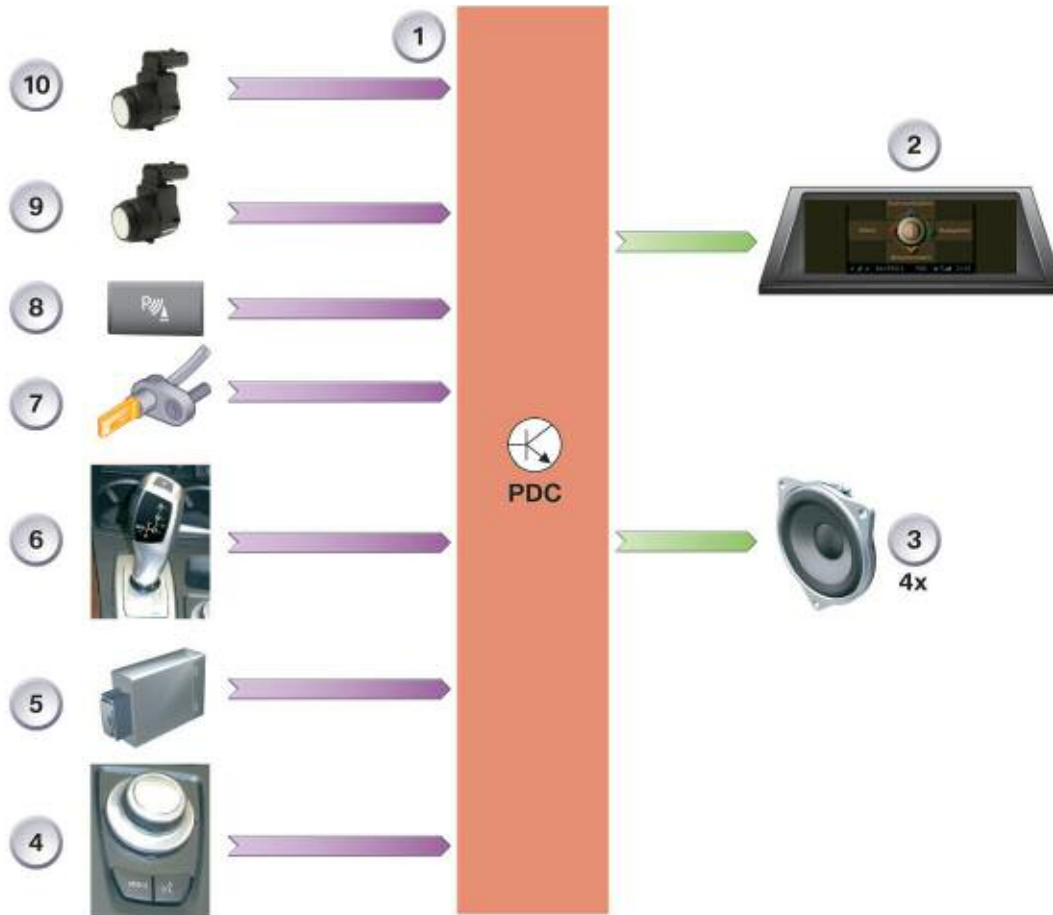
The park distance control can be switched on and off by means of a button in the center console switch cluster SZM.

The following changes/new features have been implemented compared to the predecessor models:

- New converter and new control unit
- Visual representation of distance to obstacle
- Audible signalling through radio speakers



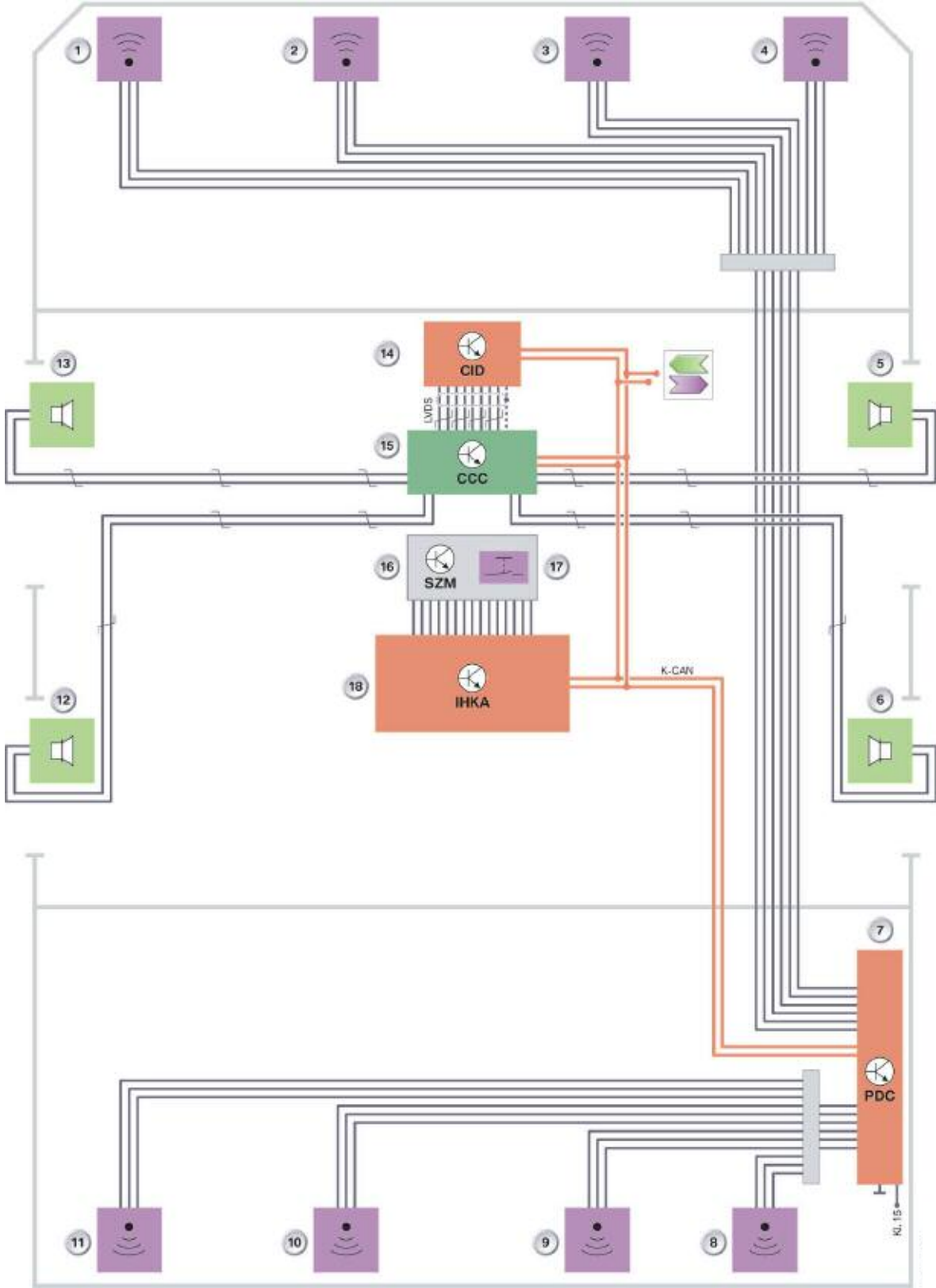
## Input/Output - Park Distance Control



Index	Explanation	Index	Explanation
1	Park distance control	6	Gear selector lever
2	Central information display CID	7	Wheel speed sensor
3	Speaker	8	Park distance control button
4	Controller	9	Rear transducer (ultrasonic sensor)
5	Trailer module	10	Front transducer (ultrasonic sensor)

With the aid of the controller (4), representation of the park distance control (1) can be set on the central information display (2). The trailer module (5) informs the park distance control whether a trailer is hitched to the vehicle in order to deactivate the rear transducers (9). Park distance control is activated on engaging reverse gear with the gear selector lever (6). The park distance control can be switched on/off with the button (8). Corresponding to the setting of the park distance control system, the driver can be informed both acoustically (3) and visually (2) of the distance to the nearest obstacle while parking/ maneuvering . The audible information is always available when the park distance control is activated.

# System Circuit Diagram - Park Distance Control



Legend for System Circuit Diagram - Park Distance Control

Index	Explanation	Index	Explanation
1	Front left transducer (ultrasonic sensor)	12	Speaker, rear driver's side
2	Front center left transducer	13	Speaker, front driver's side
3	Front center left transducer	14	Central information display CID
4	Front right transducer	15	Car communication computer*
5	Speaker, front passenger's side	16	Center console switch cluster
6	Speaker, rear passenger's side	17	PDC button
7	Park distance control PDC	18	Integrated automatic climate control IHKA
8	Rear right transducer	K-CAN	Body CAN
9	Rear center right transducer	KL15	Terminal 15
10	Rear center left transducer	LVDS	Low voltage differential signal
11	Rear left transducer		

K-CAN Signals at Park Distance Control

In/Out	Information	Source	Function
In	Vehicle speed signal	Rotation rate sensor >dynamic stability control >junction-box ECU>instrument cluster	Deactivation of park distance control as from 12mph/20 km/h
In	Distance signal	Rotation rate sensor > dynamic stability control > junction-box ECU> instrument cluster	Deactivation of park distance control after distance of 50 m
In	Outside temperature	Outside temperature sensor > instrument cluster	Temperature is one of the reference variables for calculating distance
In	Trailer	Trailer socket towing hitch > trailer module	Rear park distance control deactivated when trailer is connected
In	Reverse gear status	Gear selector lever > electronic transmission control	Park distance control ON, with reverse gear engaged
Out	Check control message	Park distance control	Display of CC message

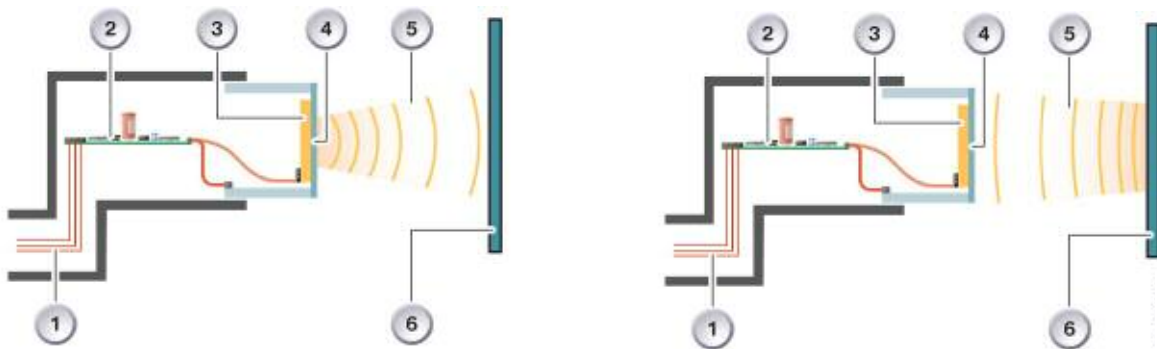
# Functions

## Functional Principle of the Ultrasonic Sensors

Operation of the ultrasonic sensors is based on the echo-sounding principle.

Short ultrasonic pulses are sent out by the ultrasonic sensor, reflected from objects in the vicinity and received again by the ultrasonic sensor.

The ultrasonic sensor sends the period of time required between sending the ultrasonic pulse and receiving the first echo to the park distance control module which, in turn, calculates the distance to the nearest object from this period of time.



Index	Explanation	Index	Explanation
1	Ultrasonic sensor connection	4	Outer diaphragm
2	Ultrasonic sensor electronics	5	Ultrasonic waves
3	Piezo-ceramic element	6	Obstacle/wall

## Send Mode

The ultrasonic sensor behaves as a "speaker" in send mode.

At about 40 kHz to 50 kHz, the selected ultrasonic frequency is outside the range in which people, pets and domestic animals are not adversely affected.

The electronics of the ultrasonic sensor produces electrical pulses to set the Piezo-ceramic element in motion (conversion of electrical energy to mechanical energy).

The Piezo-ceramic element is located on the inside of the outer diaphragm. The outer diaphragm vibrates in line with the resonance frequency and produces ultrasonic waves. The short pulse sequences hit an obstacle and are bounced back (reflected).



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## Receive Mode

The ultrasonic sensor behaves as a "microphone" in receive mode.

After the outer diaphragm has settled (about 1 ms), the ultrasonic sensor receives the ultrasonic waves reflected by the obstacle. Vibrations are induced in the outer diaphragm and Piezo-ceramic element which transfer the electrical pulses to the electronic ultrasonic sensor module.

The electrical measured signal is digitized and sent to the park distance control. The data are processed in the park distance control module and the distance to the obstacle calculated.

The echo propagation time is calculated from the start time of sending the signal and from the time of the incoming echo. Based on the known ultrasonic speed in air, the echo propagation time is a measure for the distance to the obstacle.

## Function Activation

The park distance control performs a system test after switching on the ignition. The park distance control is ready for operation after the system test has been successfully completed. Any system faults are indicated in the form of check control messages in the instrument cluster and central information display.

## Automatic Activation

The park distance control is activated automatically by engaging reverse gear. Activation takes place with a delay of about 1 second. This delay prevents unintentional activation of the park distance control when passing through the R-position when changing the drive range.

On vehicles equipped with a central information display, it is possible to select whether the distance to the obstacle is to be indicated visually.

## Automatic Deactivation

The front and rear park distance control remains active after disengaging reverse gear. Automatic deactivation of the park distance control is initiated under following conditions:

- Vehicle speed greater than 12 mph/20 kmh
- Distance greater than 50 m

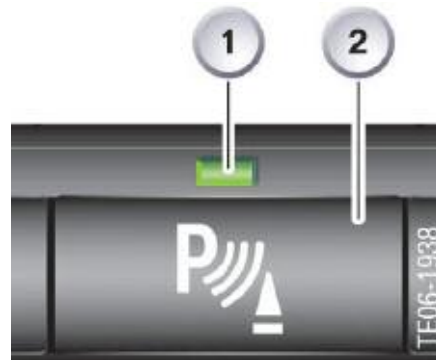
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## Manual Activation

The park distance control can be switched on or off by pressing the PDC button (2).

Illumination of the function indicator (1) in the PDC button indicates that the park distance control and therefore the distance recognition function is active.

Manual activation of the function is possible only up to a road speed of about 12 mph / 20 kmh.



Index	Explanation
1	Function indicator
2	PDC button

Note: The signal from the PDC button is evaluated by the integrated automatic climate control. The integrated automatic climate control sends the signal via the K-CAN to the park distance control.

## Distance Signalling

The distance between the vehicle and an obstacle is always signalled audibly. The representation can be additionally activated on the central information display showing a schematic representation of the vehicle and the obstacles.

## Audible Distance Signalling

Corresponding to the vehicle equipment, the distance is signalled audibly through the speakers of the audio system.

The signal frequency changes corresponding to the distance of the vehicle to the obstacle. The shorter the distance of the vehicle from the obstacle the faster the tone sequence. A continuous tone is output at a distance below about 30 cm.

As the vehicle moves away from the obstacle, the audible signal is immediately switched off as soon as the distance changes by more than 10 cm. This tolerance range is necessary to ensure that small changes in distance (<10 cm) do not result in deactivation of the audible signal.

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To avoid irritating the driver, the signal tone of the park distance control (outer ultrasonic sensor(s)) is switched off after about 3 seconds when driving very close to and along a wall. The prerequisite is that the distance is outside the continuous tone range (> 30 cm). The audible signal is sounded again on approaching this range.

#### Front Detection Range

The detection range for the audible warning at the front is:

- Left/right about 60cm
- Center about 70cm

#### Rear Detection Range

The detection range for the audible warning at the rear is:

- Left/right about 60cm
- Center about 150cm

#### Audio System

The audio system (car communication computer) receives the signals via the K-CAN from the park distance control for the purpose of audible distance signalling. The audio system processes the signals, after which the audible signal for the speakers is generated. Parallel to this, the distance is shown visually on the central information display.

Note: Signal processing takes place in the CHAMP if no car communication computer is installed.

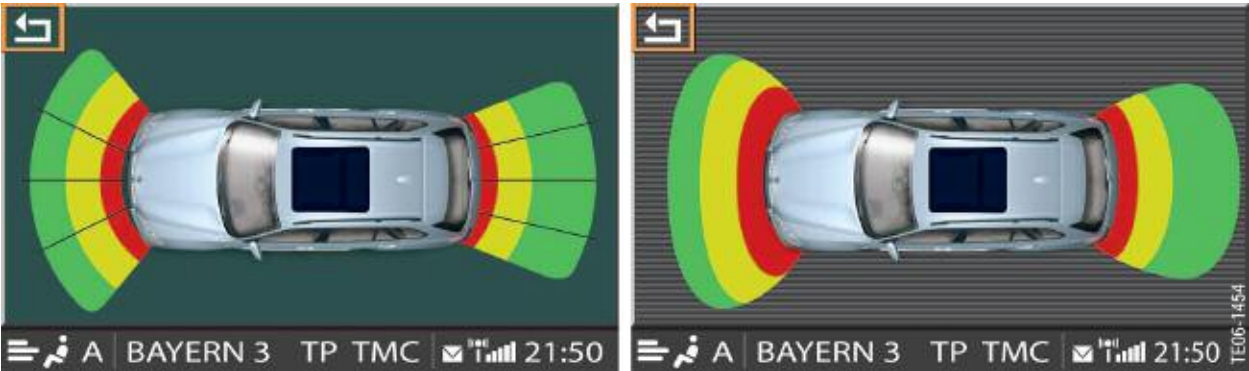
In order to better locate small obstacles as well as obstacles located only on one side of the vehicle, only the speaker installed on the corresponding side of the vehicle is activated when the obstacle is detected by an outer ultrasonic sensor.

This function to distinguish between left and right can be disabled by way of coding. The obstacle closest to the vehicle is indicated. The mid-range speakers on the left and right are activated as soon as a centrally positioned ultrasonic sensor detects an object.

The audible signal is not output simultaneously at the front and rear. If the distance of the obstacles to the front and rear of the vehicle is below about 30cm, the audible signal is output alternately at the front and rear at 1 second intervals.

# Visual Distance Signalling

In the E70, the distance to an obstacle can also be indicated visually. The visual display can be permanently switched on or off by means of the controller for the central information display. The audible indication always remains active.



The park distance control is shown in the central information display when visual distance signalling and park distance control have been activated.

The visual distance signalling indicates obstacles earlier than the audible signalling. The acquisition range is up to 250 cm. The vehicle and the obstacles are shown in a top view.

The grey background represents the monitored area. The obstacles in this area are shown in green, yellow and red corresponding to the distance from the vehicle.

The audio system receives the distance information between the ultrasonic sensors and the obstacle from the park distance control via K-CAN and generates the corresponding graphic representation.

The central information display outputs the information and superimposes this representation on the central information display.

The previous display is shown automatically in the central information display when the park distance control is switched off. The display ranges at the front/rear are identical and shown in the following table.

Distance from obstacle in cm

Distance from obstacle in cm		
Green	>100	>100
Yellow	50 to100	50 to100
Red	<50	<50

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## Trailer Mode

When pulling a trailer, the trailer module informs the park distance control via the K-CAN that a trailer is hitched to the vehicle. The park distance control deactivates the ultrasonic sensors for the rear area of the vehicle.

Note: The park distance control receives the information that the trailer is hitched to the vehicle only when the trailer lighting is connected.

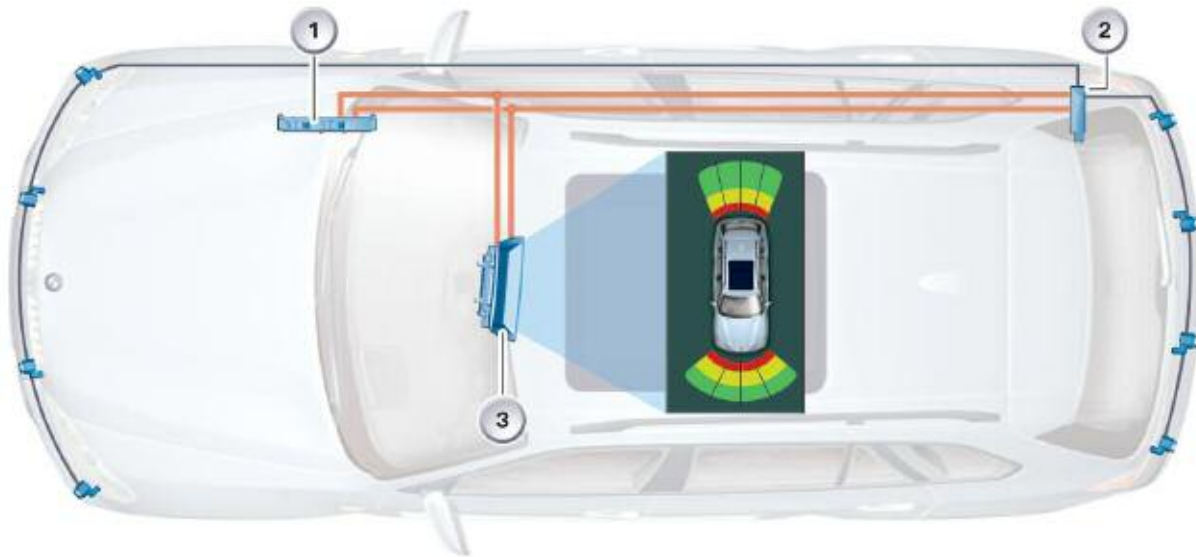
## Rear-view Camera

The rear-view camera can be combined with the data made available by the park distance control. For instance, obstacles detected by the park distance control can be shown in the real image of the rear-view camera.

The image is shown on the central information display. The image of the rear-view camera is optional and can be switched over to the central information display. This function can be set by means of the controller. The audible park distance control remains active.

More detailed information on changeover functions and possible representations can be found in the Product Information "Rear-view camera E70".

# System Components



Index	Explanation
1	Junction-box ECU
2	Park distance control
3	Central information display

## Ultrasonic Sensors

The ultrasonic sensors fitted in the E70 offer new product advantages such as greater range and optimized design.

### Greater Range

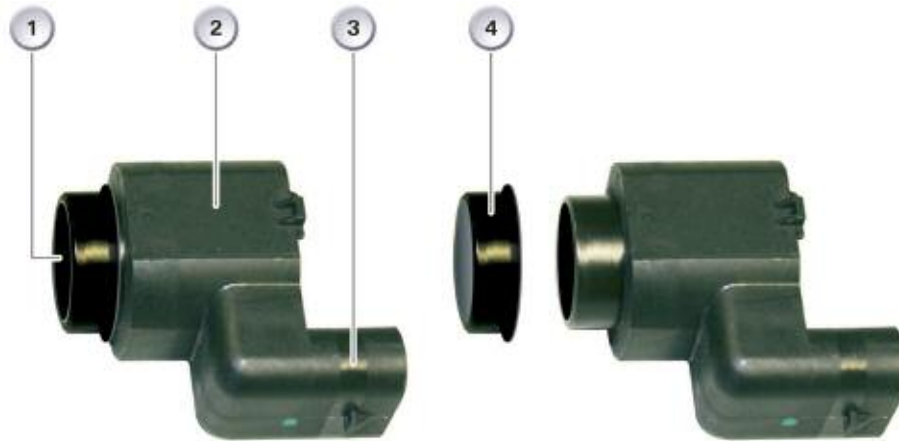
The range of the new ultrasonic sensors is about 250 cm. The entire range of the ultrasonic sensors is used for visual distance signalling. The ultrasonic sensors are reduced to a range of minimum 150 cm for acoustic distance signalling.

### Optimized Design

The new ultrasonic sensors are about 50% shorter than the previous ultrasonic sensor and have a smaller diaphragm (important for design). The smaller diaphragm has been made possible by new design methods.

The diaphragm is no longer decoupled from the bumper trim in the ultrasonic sensor itself but rather it is now decoupled by means of a de-coupling ring.

The installation of the De-coupling ring is essential and ensures trouble-free operation. The transmission and reception quality may be reduced if no or an incorrect De-coupling ring is fitted. In addition, the park distance control can trigger a continuous tone although there is no obstacle in the detection range of the ultrasonic sensor. The De-coupling ring does not serve as a seal.



Index	Explanation	Index	Explanation
1	Outer diaphragm	3	Connection socket
2	Sensor housing	4	De-coupling ring

The ultrasonic sensors can amplify the echo signals and convert them into digital signals. A bidirectional data line is used for transmitting data to the park distance control. For this reason, all ultrasonic sensors are connected by means of a 3-pin waterproof plug connection to the wiring harness.

Electrically and mechanically, all ultrasonic sensors are of identical design. Adaptation to the respective bumper is achieved by way of variant encoding. These data are specific to the type and vehicle and depend on the installation location.

To ensure the ultrasonic sensors can be used universally, the corresponding data are sent from the park distance control module to the ultrasonic sensors every time the park distance control is activated.

This means the ultrasonic sensors of one vehicle can be interchanged as part of a troubleshooting procedure.

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#### Wiring harness, front ultrasonic sensors

The wiring harness is one-piece from the control unit up to the bumper, where the wiring harness is split and connected to the individual ultrasonic sensors.

#### Wiring harness, rear ultrasonic sensors

The wiring harness is one-piece from the control unit up to the bumper, where the wiring harness is split and connected to the individual ultrasonic sensors.

#### Power supply of ultrasonic sensors

The positive connection and ground connection are routed individually up to the bumper. The power supply is split in the bumper and routed to the ultrasonic sensors.

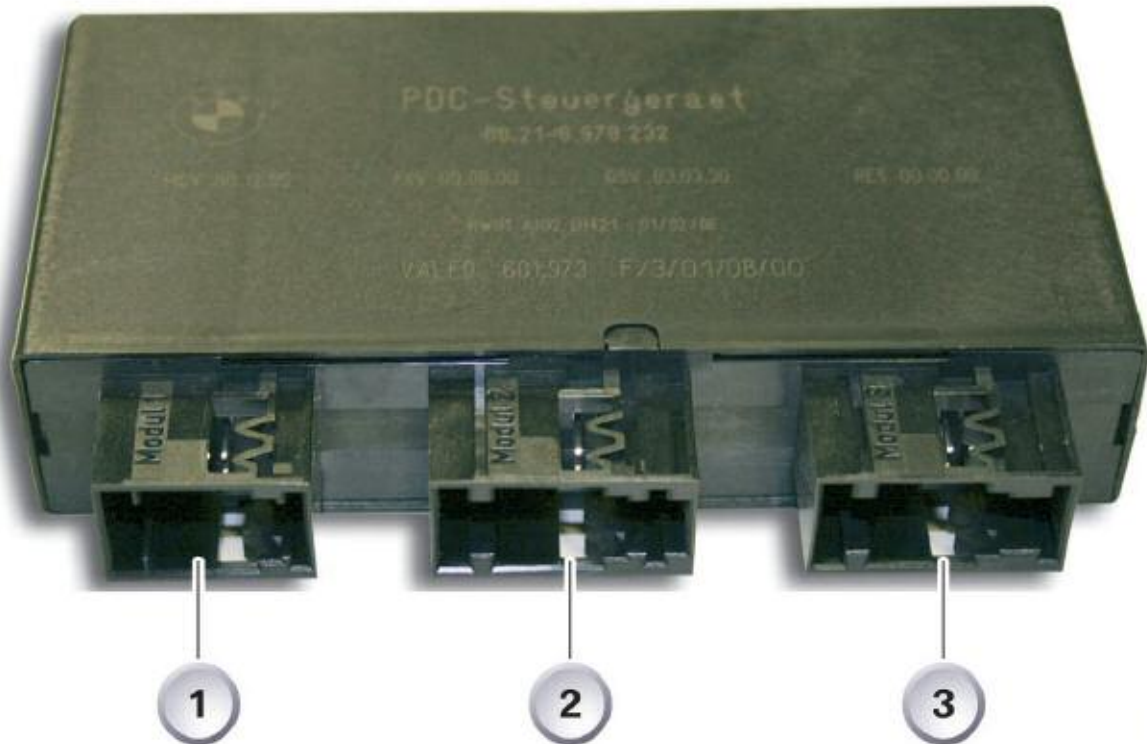
### Park Distance Control with Eight Channels

The control unit for the park distance control in the E70 is an 8-channel system. Activation of the audible and visual distance signalling is dependent on the audio system.

The park distance control unit is installed on the rear right in the luggage compartment. The park distance control unit has three connectors for the version with four sensors for the front and four sensors for the rear area of the vehicle



## Park Distance Control Module



Index	Explanation
1	Connection, bus
2	Connection, rear sensors
3	Connection, front sensors

## Park Distance Control Functions

The main functions of the park distance control are:

- To activate the ultrasonic sensors
- To evaluate the received echo pulses
- To output the signals for audible and visual driver information
- Bus communication

The park distance control additionally monitors correct operation of all ultrasonic sensors. In the event of a fault, the corresponding message is indicated to the driver (check control message) and the fault code is stored in the fault code memory. The park distance control (control unit) is constantly operational as from "Terminal 15 ON" even if the function is not active.

# Service Information

## Diagnosis

The ultrasonic sensors must be clean and free of ice to ensure effective operation. Check following points before performing the diagnostic procedure:

- Check mechanical condition of ultrasonic sensors. Make sure that the ultrasonic sensors are fitted correctly in their retaining fixtures and are free of dirt, ice and snow. A reoccurring fault symptom is that the customer complains about the continuous tone in the park distance control but the system operates correctly in the workshop. This problem is caused by ice or dirt on the sensors.
- During troubleshooting, there must be no objects closer than 40 cm from the detection range of the ultrasonic sensors.
- Ensure the De-coupling element is fitted correctly on the ultrasonic sensor. Otherwise problems may be encountered in transmitting and receiving signals.

The park distance control unit monitors the following system components for breaks (open circuit) or short-circuits and if problems occur corresponding fault codes are stored in the fault code memory:

- Data lines to the ultrasonic sensors
- Power supply of the ultrasonic sensors

## System Limits

The park distance control cannot replace the driver's own estimation of the distance to obstacles. Sensors also have a "dead" zone in which objects can no longer be detected. Detection of objects can come up against the physical limits of ultrasonic measurement when the ultrasonic waves are not or poorly reflected, e.g. thin objects. Low objects already indicated can "disappear" again before a continuous tone is sounded (a high curb stone). Loud sources of noise outside and within the vehicle can drown out the signal tone of the park distance control. The driver therefore remains responsible for estimating obstacles even in vehicles equipped with park distance control.

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The park distance control can trigger a warning under the following conditions even though there is no obstacle in the detection range:

- Ultrasonic sensor not fitted correctly in its retaining fixture
- In heavy rain
- Ultrasonic sensors dirty or iced up
- Ultrasonic sensors covered in snow
- Exhaust gasses
- Echo pulses caused by the natural surroundings, like extremely rough road surface or grass
- In large, rectangular rooms with smooth walls, like in underground parking garages (superimposition of reflected echo pulses)
- Fault triggered by connected towing hitch or of unevenly fitted cap on ball head of towing hitch.

## Cleaning the Ultrasonic Sensors

The ultrasonic sensors must be clean and free of ice to ensure effective operation. When washing the vehicle with a high pressure washer, do not direct the spray continuously at the ultrasonic sensors and maintain a minimum distance of 10 cm.

## System Error

A check control message is shown in the instrument cluster and in the central information display to indicate a fault in the park distance control.

This symbol appears in the instrument cluster.

In addition, the following text appears in the status line of the central information display:

- "PDC failed"
- The following text can be selected in the "Check control messages" sub-menu of the "BMW Service" menu.
- "Park Distance Control (PDC) failed. Have the problem checked by your BMW dealer as soon as possible."

